

UTILITY PATENT APPLICATION
UNDER 37 CFR 1.53(b)

Assistant Commissioner for Patents
Washington D.C. 20231

Case Docket No. 4393-002

Sir:

Transmitted herewith for filing is the patent application of:

INVENTOR: F. John HERRINGTON

FOR: RIBBED CORE DUAL WALL STRUCTURE

Enclosed are:

- ☒ 31 pages of specification, claims, abstract
- ☒ Declaration & Power of Attorney
- ☒ Priority Claimed
- ☐ Certified copy of
- ☒ 8 sheets of formal drawing
- ☐ An assignment of the invention to and the assignment recordation fee
- ☒ Return Receipt Postcard
- ☒ A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27
- ☒ Information Disclosure Statement, Form PTO-1449
- ☒ Copies of IDS Citations
- ☐

The filing fee has been calculated as shown below:

	NO. FILED		NO. EXTRA	RATE	AMOUNT
Total Claims	24	MINUS 20	4	x \$9 =	\$ 36.00
Independent Claims	3	MINUS 3	0	x \$39 =	\$ 0.00
If multiple dependent claims are presented, add \$130.00					\$0.00
Basic Fee					\$ 345.00
Total of above calculations					\$ 381.00
<input type="checkbox"/> Assignment and Recording Fee					\$0.00
TOTAL FEE					\$ 381.00

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Respectfully submitted,

LOWE HAUPTMAN GOPSTEIN
GILMAN & BERNER, LLP



Michael G. Gilman

Registration No. 19,114

1700 Diagonal Road, Suite 310
Alexandria, Virginia 22314
(703) 684-1111
(703) 518-5499 Facsimile
Date: July 27, 2000
MGG/vgg

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of :
F. John HERRINGTON :
Serial No. :
Filed: :
For: RIBBED CORE DUAL WALL :
STRUCTURE :

Assistant Commissioner for Patents
Washington, DC 20231

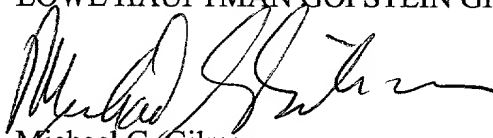
Sir:

Transmitted herewith for filling in the above-referenced application is (are) the following:

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS –

Respectfully submitted,

LOWE HAUPTMAN GOPSTEIN GILMAN & BERNER, LLP



Michael G. Gilman

Registration No. 19,114

1700 Diagonal Road, Suite 310
Alexandria, Virginia 22314
(703) 684-1111
(703) 518-5499 Facsimile
Date: July 27, 2000

Applicant or Patentee: F. John HERRINGTON Attorney's Docket No.: 4393-002
Serial or Patent No.: _____
Filed or Issued: _____
For: RIBBED CORE DUAL WALL STRUCTURE

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) and 1.27(b)) - INDEPENDENT INVENTOR

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled RIBBED CORE DUAL WALL STRUCTURE described in

- ☒ the specification filed herewith.
☐ application serial no., filed.
☐ patent no., issued.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below

- ☒ no such person, concern or organization
☒ person, concerns or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME: _____
ADDRESS: _____
☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

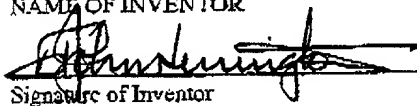
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I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

F. John HERRINGTON
NAME OF INVENTOR


Signature of Inventor

7/26/00
Date

RIBBED CORE DUAL WALL STRUCTURE

GENERAL FIELD OF THE INVENTION

This invention relates to generally tubular articles such as cores for rolled goods like carpets and plastic film. It more particularly refers to such cores that are light in weight and have unusually high crush resistance. It further relates to decorative toy articles made from such tubular articles.

BACKGROUND OF THE INVENTION

Cores for all kinds of rolled goods, such as plastic film, carpeting, paper products, and the like, are well known. In many instances, these cores are simply hollow cylindrical rolls of cardboard or other materials. In other cases, these cores may be solid plastic, wood or metal rods.

In one very old patent, United States 3,627,221, there is described a decorative end plug for rolled paper, such as newsprint. The end plug is made up of a centrally located opening for receiving an axially disposed shaft, a generally flat, solid, disc like portion 16 disposed radially about the shaft receiving axial opening 18, and a peripheral rim portion 20 disposed radially around the disc portion 16. From a consideration of Fig.

1 of this patent, it appears that a core 12 of the paper roll 10 is intended to fit about the rim portion 20. Put another way, the described end plug is intended to fit within the core of the roll of paper and the shaft (unnumbered) that will support the assembly is intended to pass through the axial opening 18 in the end plug.

The peripheral rim portion 20 of this disclosed end plug appears to be composed of a "U" shaped member that is made up of two concentric elements 26 and 30 that form the arms of the "U". A series of webs 34 and 36 appear to span the top of the "U". These webs and the arms of the "U" are so arranged as to form generally triangular areas or cells 38. This end plug is intended to help to support the ends of the paper roll on its cylindrical paper core. The depicted end plug is generally flat in cross section and is not disclosed to pass axially all the way through the paper roll or its cylindrical paper core. In fact, this end plug is characterized by having a diameter that is substantially larger than its depth, that is, it is a disk-like shape rather than a tube-like shape. The end plug is said to taper inwardly in thickness from its periphery toward the central opening in order to increase its resiliency during its insertion into the end of the paper roll. The '221 patent says that the depicted flat, disc like end cap may be made of molded plastic, such as polyethylene. It is clear that the depicted end cap is not suited to have paper or other flat goods rolled up on it, but is only suited to be inserted into the end of an already made roll of paper or the like. Despite the support that the end plug of the '221 patent may give to the ends of the internal tubular paper central tube, the paper core 12 must be self supporting and able to withstand the weight of the paper rolled thereon over substantially the whole of its length.

It is to be noted that the '221 patent states that the disclosed end plug is intended to help protect the already made roll from damage during loading and unloading and during transit, not during the making of the roll of paper. This distinguishes that end plug of the prior art from the core structure of the instant invention which is intended for use in creating the roll of flat goods, especially stretch or shrink wrap plastic film (hereafter generally referred to as shrink wrap plastic film). The crush stress that is applied to the core by shrink wrap plastic film is substantially greater than what is applied by newsprint, and this stress increases with the amount of shrink wrap film that is wound on the central core. It increases further with the shrinkability of the film being wound and with the speed of winding of the film. Therefore, modern wrapping techniques use solid cores to support most industrial sized rolling of flat goods, from carpet to plastic film.

Solid wood plastic or steel rollers are quite heavy and add to the shipping costs of the material rolled on them. Further, solid cores of these materials are expensive and, although efforts at recycling have been attempted, they have not met with great success. The cost of the cores must then be added to the cost of the material that is wrapped on the cores. It is obvious that making the cores hollow and thin walled will substantially reduce their weight, and therefore their cost, and will also reduce the weight of the entire rolled product whereby reducing shipping costs as well. The problem with using hollow cores, however, is that hollow tubes necessarily have lower crush strength than solid cylinders of the same diameter and material. Further, and the thinner the walls of hollow cores, the less is their crush resistance. It has therefore been thought that the tradeoff

between the weight and cost of the core and the crush strength of the core was just something the art had to accept, with the proper core selected for each application.

OBJECTS AND DESCRIPTION OF THE INVENTION

It is an important object of this invention to provide a hollow core tubular article, that can be used for, among other things, supporting rolled goods thereon.

It is an object of this invention to provide such a tubular article that is lighter in weight than previous similar articles, and yet has a substantially higher crush resistance than has been achieved in the past.

It is a further object of this invention to provide such a tubular article that has sufficient radial crush strength to support the stress of substantial quantities of flat goods, particularly shrink wrap plastic film, thereon.

It is another object of this invention to provide a method of making relatively inexpensive, crush resistant hollow tubes that are suited for use as cores in supporting rolled flat goods.

It is a still further object of this invention to provide novel means for improving the roundness of tubular articles, particularly hollow tubular articles that are made by an extrusion method.

It is a still further object of this invention to provide an improved method of making tubular articles of substantial length that have more consistent diameters than has been achievable in the past.

It is still another object of this invention to make a novel entertainment or toy article that is derived from the hollow tubular articles made according to this invention.

Other and additional objects of this invention will become apparent from a consideration of this entire specification, including the drawing hereof.

In accord with and fulfilling these objects, one aspect of this invention is an elongated hollow tubular article, sometimes referred to herein as a composite tube, comprising a smaller diameter inner, generally hollow, tubular element and a larger diameter outer, generally hollow tubular element with at least one web of material disposed between, and attached to, both the inner and outer elements. The intermediate web(s) of material enable the inner and outer tubes to maintain their radial spacing from each other. Preferably there are a plurality of such webs of material disposed between, and attached to, both the inner and outer elements or walls. These plural webs are suitably spaced from each other. Most preferably, these ribs or webs are substantially equidistantly spaced apart angularly (sometimes hereinafter referred to as radially spaced apart ribs) within the toroidal area between the inner and the outer tubes. These plural webs or ribs are preferably disposed in locations such that at least some of them, and preferably all of them, contact, and support, the radial spacing of both the inner and outer

tubes, respectively, at locations where other such ribs also contact the inner and outer walls respectively. Put another way, each rib contacts the inner and outer tube and at the same time contacts, or at least is close to the point where the next adjacent rib also contacts, either the inner or the outer tubular wall, respectively. In one embodiment of this invention, this configuration causes a rib to be in contact with its next adjacent rib at the same time as it is in contact with one of the inner or outer tubes whereby forming generally triangular strut-like members. In another embodiment, this configuration causes a rib to be closely adjacent to its next adjacent rib at the point where it contacts either the inner or outer tubular wall whereby forming generally trapezoidal strut-like members.

Preferably, each rib contacts both ribs that are next adjacent on each side thereof at the same time as it contacts the inner and outer tubular walls, respectively, or is at least proximate to both of these next adjacent ribs at the point where it contacts both the inner and outer walls, respectively. This structure includes a rib structure between the inner and outer tubes where each rib and its next adjacent rib, together with the wall of the tube that is enclosed by the two next adjacent ribs, defines a series of substantially triangular or trapezoidal cells formed by one tube and two ribs each. These cells are not exactly triangular in cross section because the tube wall of the cell is arcuate and therefore the cross section of the cells is only approximately triangular or trapezoidal, respectively.

It is a preference in the structure of the composite tube of this invention to slightly space the ribs apart at the points where they intersect the arcuate wall of one of the tubes.

In this manner, the preferred cellular structure, having a cross section that approximates a partially spherical trapezoid, is formed. The slightly trapezoidal shape of the spacing cells has been found to be desirable and an improvement over the triangular cell cross section because, when the composite tube of this invention having generally trapezoidal cellular ribs is made by extrusion of molten plastic or metal material, an excess of the rib material does not accumulate at the point where the ribs contact the inner or outer tubular walls, respectively.

It is preferred that each rib extend the whole length of the composite tubular article of this invention, and that it contact and be adhered to and support both of the inner and outer tubes, respectively, along its entire length. However, this is not an absolute requirement. The ribs(s) may be attached to the inner and/or outer tubes at intermittent areas so long as the total amount of attachment is sufficient to accomplish the purposes of this invention, that is to maintain substantially consistent spacing between the inner and outer tubes while at the same time providing sufficient radial support to avoid the composite tube being crushed by the flat form film or sheet material wound thereon.

The rib(s) should preferably extend continuously from one end of the composite tubular structure of this invention to the other, but this is not an absolute requirement. The rib(s) may be interrupted along their length, and/or, any one or more of them may extend only part way along the entire length of the composite article. It is important that the ribs as a collective whole extend substantially the entire length of the tubular article because where there are no ribs, there is no structure to maintain the spacing between the

inner and the outer tubes. Under these circumstances, the composite tubular article could be crushed and collapse, under the radial stress of the flat goods rolled thereon, whereby defeating the entire purpose of this invention.

The ribs can be generally rectangular in cross section, but this geometric shape is not an absolute requirement of this invention. The ribs may have a triangular or trapezoidal, or any other desired, cross section. Further, although it is preferred that the ribs be substantially constant in cross section and area over their entire length, the cross sectional area and/or geometry of the rib(s) may change over the length of the composite tube. The geometry and cross section may also, or alternatively, change from rib to rib, as appropriate. Any combination of these parameters is considered to be within the scope of this invention.

The preferred mode of operation of this invention is to provide a plurality of ribs substantially uniformly angularly distributed about the periphery of the outside surface of the inner tube (and consequently about the inner surface of the outer tube). The cross section of each rib is preferably the same from rib to rib and along the entire length of the ribs, and is substantially rectangular. The cells formed between the next adjacent ribs and the walls of the inner and outer tubes may be generally triangular in cross section, but are preferably all substantially trapezoidal in cross section.

It is well known that triangular shapes are the strongest structural shapes for a given weight and type of material, and that the further the structure departs from a true

triangle, the less rigid and strong is the resulting shape. Therefore, the trapezoidal shapes of this embodiment of this invention give up some of their strength in exchange for lighter weight and lower cost (because of less material being used). It is therefore preferred that the length of the smaller leg of the trapezoid be no more than about 10% of the length of the longer leg of the trapezoid. Of course it will be realized that these trapezoidal legs that are being referred to here are not straight as in the real trapezoid geometric shape, but rather are segments of the arcuate walls of the inner and outer tubes. The truss sections are therefore geometric shapes that approach a trapezoid, rather than actually being an exact trapezoid.

The inner and outer walls are preferably concentric, but they may depart from absolute concentricity in that one or the other may be eccentric, that is not of circular cross section. In the alternative, the tubular walls may be out of concentricity by both of the tubular walls being of circular cross section but having centers that are not coincident. The ribs must be of such a size and shape as to follow any eccentricity that may exist. The term "concentric" will be applied to the inner and outer tubes of this invention in this specification and the claims appended hereto in this broad sense, that is sufficiently concentric to accomplish the purposes of this invention, but not necessarily absolutely concentric. The term, "concentric" should therefore not be taken as a structural limitation on the articles of this invention but rather as a description of the relationship between the walls as being inner and outer.

The inner and outer walls of the composite tubes of this invention may be the same or different, but are preferably of circular cross section. Their cross sections may be of other shapes, such as elliptical, or for that matter any shape that suits the ultimate use to which the core will be put. Of great important to the article of this invention is the disposition of longitudinal ribs between, and joining, the inner and outer tubes, and supporting each of them. The combination of the "off-radial" disposition of the longitudinal ribs (that is to form generally trapezoidal truss cells), and the inner and outer tubular walls creates a structure that withstands substantially greater crushing forces than would either the inner or the outer walls by themselves, or even a single wall having the thickness of the inner and outer tubes combined.

These above described ribbed hollow wall cylindrical cores have performed very well in tests conducted to determine their crush resistance. It has been found that the "off-radial" ribbed (trapezoidal) structure is substantially stronger and more crush resistant than a hollow wall core with only spaced radial ribs. It has been found, however that when the bi-wall composite tube of this invention is squeezed between flat plates, such as is approximated by closing the jaws of a vise, the mode of failure of the structure is a buckling of some of the inner and outer tube wall segments between the ribs (off-radial or radial) that are proximate to the jaws of the vise. The forces acting on the hollow wall cores when pressed between flat, diametrically opposed plates is to compress the outer wall of the portions of the core that are in contact with the pressure plates of the vise, and to compress the inner wall in those locations that are 90° from the points where the pressure is being applied. It is these specific inner and outer wall segments,

respectively, that buckle first. Where the ribs are generally longitudinal in disposition, the wall buckling progresses all the way down the length of the composite structure of this invention between the ribs as aforesaid.

According to a most preferred aspect of this invention, therefore, the ribs are disposed in a helical pattern along the length of the toroidal space between the inner and the outer tubes. In this manner, a buckling of any one rib element, by reason of pressure being applied in the radial direction between flat plates, will not have an unimpeded longitudinal path from one end of the composite tube structure of this invention to the other. Rather, as the ribs pass helically about the hollow inner wall, they form places where they will be disposed directly in the path of the pressure being applied by the opposing flat plates as aforesaid, and will thereby act as a stop to the progression of buckling.

An unexpected advantage of composite tube of this invention, having helical ribs as aforesaid, is that they unobviously show better consistency of diametral dimension, e.g. the roundness, in the case of a circular cylindrical composite tube, as compared to composite tubes made using ribs that are merely longitudinal, and not helically disposed about the length of the composite tube, assuming the manufacturing precision is the same in both cases. In the case of helical ribbed composite tubes of this invention, these same considerations apply regardless of the cross sectional shape of the ribs, or their being radial or off-radial, as has been described herein.

The helical ribs can be disposed radially between the inner and outer walls in a position that is normal to both walls. They are preferably disposed "off-radial" so as to form helically disposed triangular or trapezoidal trusses. They can most preferably be disposed so as to form substantially trapezoidal truss shapes as aforesaid. In all of these cases, the same considerations as have been set forth above apply.

Producing helically ribbed twin walled composite tubular structures is not an easy accomplishment. Conventionally, the inner and outer tubes are extruded in a linear direction, with the inner and outer tubes being generally concentric to each other. The rib forming material is disposed by simultaneous extrusion in the same manner as in making longitudinal radial or "off-radial" ribs. Immediately upon the extrudate emerging from the extruder die, and before the extrudate has had an opportunity to harden, such as by cooling, the hollow walled composite tube is simultaneously taken away and twisted at a speed sufficient to draw down the walls to their desired final thickness as well as form the ribs into their desired helical pitch. The speed of extrusion and the speed of twisting of the extrudate must be closely coordinated to insure that the helical ribs are properly formed.

In making a product with helical ribs, it is necessary to provide relative rotation of the extruded product as it exits the die. This can be done in either of two ways: rotate the die while pulling the molten composite tube straight out in an axial direction, or keep the die stationary and rotate or twist the exiting composite tube as it is pulled away from the die. The technique of rotating the die is well known in the plastics extrusion industry and

is quite applicable here. However, it has been found that the better approach is to maintain the die in a stationary condition and rotate the extruded composite tube. This can be accomplished by twisting the exiting tube to produce helical rib forms. It is preferred to accomplish this by using a novel mechanism that is described below.

The novel puller of this invention comprises a belt wound helically around the extruded tubular product. As the belt is driven, it pulls the tube downstream and simultaneously rotates it. One difficulty encountered by this operation is that the tension on the belt inherently applies sideways forces that tend to bend the tube. According to another aspect of this invention, this problem is solved by applying a second belt intertwined with the first belt, that exerts a longitudinal force in the same direction, but is out of phase with the first belt such that the sideways forces it applies to the tubular product are directly opposite to those of the first belt, effectively countering the bending forces being exerted by the first belt. This operation has the added advantage of applying a generally uniform radial squeeze so there is no flattening of the tube during pulling and twisting it..

The extrudate material may be plastic or metal. Polyethylene and polystyrene have worked well but there does not appear to be any specific limitation on the nature of the material being used to make the hollow wall cores of this invention so long as it is reasonably extrudable. The extrudability of the material is the prime consideration. Any material that extrudes well and solidified fairly rapidly, but not instantaneously, will serve as a suitable material from which to make the hollow wall composite tubes of this

invention. If needed, auxiliary heat may be applied to maintain the extruded composite tube at the proper temperature to permit it to be rotated to form the ribs into helices.

It is considered to be within the scope of this invention to make the inner and outer tubes of different materials, respectively. The ribs may be made of the same material as either the inner or the outer tube, or of a completely different material.

As the composite tubular structure of this invention is made, it is preferably cut into lengths, as appropriate. It may also be coiled into a substantially endless length of composite tubing as is conventional in the art. Also, as is conventionally done, the tube can be cut without stopping the extrusion by using a cutter that may be suitably mounted to a carriage that travels along with the moving tube. However, because the advancing tube is also rotating, provision must be made to have the carriage move linearly at the same linear speed as the tube, yet allow the tube to rotate relative to the carriage. One way that this can be done is by using a set of wheels on the carriage with their axes parallel to the tube axis, to clamp the tube during cutting. If it is permitted or desirable to stop the extrusion process a non-helical cutter may be used.

It has also unexpectedly been found that the composite tube of this invention is a suitable starting material from which to produce a novel toy. It has been found that it is possible to cut the composite tube of this invention about a helical path while it is being longitudinally extruded, or thereafter, with or without imparting helical twist to the ribs thereof. This novel product is an unusually decorative "slinky". If the composite tube of

this invention is cut along a helical line with a relatively short flight, the resulting article has the resiliency of a spring and can be suitably stretched and/or compressed in an axial direction. This article has flights that have a cross section that includes some number of ribs that have been cut along with the rest of the composite tube. On the other hand, if the helical cutter has the same flight as the helical ribs, it is possible to make a slinky with a continuous toroidal rib. The ribs maintain the spacing between the inner and the outer tube of each flight of the cut helix. It will be clear that the direction and flight distance of the helical cut must be coordinated with the pulling and twisting forces that are being applied to the extruded tube so that there is sufficient rib material to maintain the integrity of the composite walled structure in its spring shape.

The above and the following descriptions of the instant invention in all of its aspects has been exemplified by the use of one inner and one outer wall to form the composite tubular article hereof. It should be clear that this is not a limitation on the scope of this invention, but rather is illustrative thereof. A composite tubular structure with more than two walls is contemplated by this invention, and the entire disclosure hereof should be read with this in mind.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a hollow two walled tubular article with radial ribs;

Fig. 2 is a perspective view of a hollow two walled tubular article with "off-radial" ribs forming generally triangular truss members;

Fig. 3 is a perspective view, with portions cut away, of a hollow two walled tubular article with helically disposed "off-radial" ribs forming triangular truss members;

Fig. 4 is a perspective view of a hollow two walled article with "off-radial" ribs arranged to form trapezoidal truss members;

Fig. 5 is a top view of an apparatus suited to pull tubular extrusions away from the extruder and twist the same into a helical form suited to forming the product shown in Fig.3;

Fig. 6 is a front elevation of the apparatus shown in Fig. 5;

Fig. 7 is a top view of an apparatus using two intertwined pullers to pull tubular extrusions away from the extruder and twist the same into a helical form suited to forming the product shown in Fig.3 without exerting undue sideways forces on the tube;

Fig. 8 is a front elevation of the apparatus shown in Fig. 7

Fig. 9 is a perspective view of a "slinky" spring like article according to this invention; and

Fig.10 is a sectional end view of a cutter acting on the composite tube of this invention

DETAILED DESCRIPTION OF THIS INVENTION

Reference will now be made to the drawing, wherein like parts have been given like reference numbers. Referring to Fig. 1, a composite tube 10 according to this invention is made up of an inner tube 12, an outer tube 14 and a plurality of ribs 16 therebetween. Referring to Fig. 2, a modified composite tube 20 of this invention is made up of an inner tube 22, and outer tube 24, a set of "left handed" "off radial" ribs 26 and an alternating set of right handed" "off-radial" ribs 28. Note that the combination of

the inner tube, the outer tube and the two sets of ribs forms generally triangular truss cells 29. Referring to Fig. 4, a further modified composite tube 40 of this invention is made up of an inner tube 42, an outer tube 44, and a series of left and right handed alternating "off-radial ribs 46 and 48, respectively. Note that the left and right handed ribs contact and are joined to the inner and outer tubes, respectively, out of contact with each other. This is to be compared to the structure shown in Fig. 2 where the left and right handed ribs contact each other at the same place as they contact the inner and outer tubes, respectively. In Fig. 4, the truss cells 49 that have been created have a generally trapezoidal cross section.

Referring to Fig. 3, there is shown a composite tube 40 of this invention that has a cross section that is similar to that shown in Fig. 2. The composite tube 40, whose cross section was shown in Fig. 2, has been twisted to cause the ribs 46 and 48 to have a helical form.

Referring to Figs. 5 and 6, there is shown an apparatus for forming a composite tube having helical rib structures according to this invention. The extruded composite tube 50 is proceeding from right to left in this figure. A driven belt 52 is relatively tightly wrapped around the composite tube 50 in a helical configuration, and means 54 are provided for driving the belt whereby twisting the composite tube such that the internal ribs (not shown in this figure) conform to the shape depicted in figure 3.

Figs. 7 and 8 show an apparatus that is similar to that shown in Figs. 5 and 6 but with two intertwined belts 62 and 62, both pulling and rotating the tube 50 in the same direction. The first belt 52 exerts lateral forces 52a and 52b on the tube 50 which are axially displaced from each other, thus providing a bending moment on the tube 50. The bending forces are exactly equal and opposite to, and are thereby canceled by, the forces 62a and 62b that are being exerted by the belt 62. The result is that there is no total bending moment applied to the tube 50 by the twisting mechanism of this aspect of this invention.

The nature of the material of the driving belt is not particularly critical. Its surface should have sufficient coefficient of friction relative to the material of the extruded composite tube that it will be able to drive the tube without crushing or marring its surface. In most instances, the surface of the drive belt will be smooth so that it does not mar the surface of the composite tube. However, the driving belt may be used to impart a profiling to the surface of the composite tube.

Referring now to figures 7 and 8, there is shown a novel toy that is simply made from the composite tube of this invention. This toy is akin to a "slinky" and may be formed from the composite tube of this invention regardless of the material from which the tube has been fabricated. The composite tube 70 is made up of an inside wall 72, an outside wall 74, and ribs 76 disposed in supporting relationship therebetween, and forming suitably shaped truss cells 78. The composite tube 70 is suitable helically cut, using a rotating cutter 80 so as to form a helix 82 having a plurality of flights 84. The

helix can be stretched in a longitudinal directions in the same way that a spring is stretchable, but it is reasonably rigid in the transverse direction. It is possible to make the ribs and the inner and outer tubes from the same materials and in the same colors. It is preferred, however, to make these elements of different color materials so as to add to their eye appeal.

WHAT IS CLAIMED IN:

1. A composite tube comprising at least one axially elongated inner tubular wall, at least one axially elongated outer tubular wall spaced from said inner tubular wall and ribs disposed in the space between the inner and outer walls; wherein said ribs are joined to both said inner and outer walls along a sufficient proportion of the axial length of said walls to maintain the spacing between said walls.
2. A composite tube as claimed in claim 1 wherein said inner and outer walls are concentric.
3. A composite tube as claimed in claim 1 wherein at least some of said ribs are substantially normal to said inner wall.
4. A composite tube as claimed in claim 1 wherein at least some of said ribs are disposed at an angle that differs from normal with respect to said inner tube.
5. A composite tube as claimed in claim 4 wherein all of said ribs are disposed at an angle that differs from normal with respect to said inner tube.
6. A composite tube as claimed in claim 4 wherein at least some of said ribs alternate in the direction of their angle with respect to normal to said inner tube.

7. A composite tube as claimed in claim 4 wherein at least some of said ribs are simultaneously contacted and adhered to at least one said inner and outer tubes, respectively, as well as to a next adjacent rib at substantially the same location of said rib and tube so as to form generally triangular longitudinal truss cells.

8. A composite tube as claimed in claim 7 wherein all of said ribs are alternately disposed at positive and negative angles away from normal with respect to said inner and outer tubes.

9. A composite tube as claimed in claim 7 wherein said ribs are longitudinally contacted and adhered to both of said inner and outer tubes, respectively.

10. A composite tube as claimed in claim 4 wherein at least some of said ribs are simultaneously contacted and adhered to at least one said inner and outer tubes, respectively, at a location that is spaced from the location where the next adjacent ribs are contacted with and adhered to said inner and outer tubes so as to form generally trapezoidal longitudinal truss cells.

11. A composite tube as claimed in claim 10 wherein all of said ribs are alternately disposed at positive and negative angles away from normal with respect to said inner and outer tubes.

12. A composite tube as claimed in claim 1 wherein said ribs extend the entire longitudinal length of said composite tube.

13. A composite tube as claimed in claim 1 wherein at least some of said ribs are disposed helically between said inner and outer tubes.

14. A composite tube as claimed in claim 1 wherein all of said ribs are disposed helically between said inner and outer tubes.

15. A composite tube as claimed in claim 1 consisting essentially of one inner tube and one outer tube.

16. A composite tube as claimed in claim 1 wherein said tubes are concentric and have a substantially circular cross section.

17. A helically shaped article wherein at least some of the flights of said helix comprise an inner and an outer band spaced apart from each other with a plurality of ribs disposed therebetween in supporting relationship to said tubes.

18. An article as claimed in claim 17 wherein said ribs are disposed substantially normal to said inner tube.

19. An article as claimed in claim 17 wherein said ribs are disposed at an angle from normal to said inner band.

20. An article as claimed in claim 17 wherein alternating ribs are disposed at opposite angles from normal to said inner tube.

21. A method of forming an elongated composite tube as claimed in claim 14 comprising:

co-extruding a smaller diameter tube and a larger diameter tube in concentric relation to each other;

extruding a plurality of angularly spaced apart ribs so as to be disposed between, and in supporting relationship to, said smaller and larger tubes whereby forming a composite tube; and

applying an angular twist to said extruded composite tube while it is still in a formable condition, whereby causing said ribs to become helically disposed and shaped relative to said smaller and larger diameter tubes.

AMENDED CLAIMS

[received by the International Bureau on 19 January 2000 (19.01.00);
original claims 1-21 replaced by new claims 1-24 (5 pages)]

1. A composite tube comprising at least one axially elongated, substantially rigid inner tubular wall, at least one axially elongated, substantially rigid outer tubular wall spaced from said inner tubular wall, and a plurality of substantially rigid ribs disposed in the space between the inner and outer walls; wherein at least some of said ribs are disposed at angles other than perpendicular to said inner and outer walls, and wherein at least some of said ribs are joined to both said inner and outer walls along a sufficient portion of the axial length of said walls to maintain the spacing between said walls.

2. A composite tube as claimed in claim 1 wherein said inner and outer walls are concentric.

3. A composite tube as claimed in claim 1 wherein some of said ribs are substantially normal to said inner wall.

Cancel claim 4.

5. A composite tube as claimed in claim 1 wherein all of said ribs are disposed at an angle, that differs from perpendicular, with respect to said inner tube.

6. A composite tube as claimed in claim 1 wherein at least some of said ribs alternate in the direction of their angle with respect to normal to said inner tube.

7. A composite tube as claimed in claim 1 wherein at least some of said ribs are simultaneously contacted and adhered to at least one said inner and outer tubes, respectively, as well as to a next adjacent rib at substantially the same location of said rib and tube so as to form generally triangular longitudinal truss cells.

8. A composite tube as claimed in claim 7 wherein said ribs are longitudinally contacted and adhered to both of said inner and outer tubes, respectively.

9. A composite tube as claimed in claim 1 wherein at least some of said ribs are simultaneously contacted and adhered to at least one said inner and outer tubes, respectively, at a location that is spaced from the location where the next adjacent ribs are contacted with and adhered to said inner and outer tubes so as to form generally longitudinal truss cells having a substantially trapezoidal cross section.

10. A composite tube as claimed in claim 9 wherein all of said ribs are alternately disposed at positive and negative angles away from normal with respect to inner and outer tubes.

A composite tube as claimed in claim 1 wherein said ribs extend the entire length of said composite tube.

12. A composite tube as claimed in claim 1 wherein at least some of said ribs are disposed helically between said inner and outer tubes.

13. A composite tube as claimed in claim 1 wherein all of said ribs are disposed helically between said inner and outer tubes.

14. A composite tube as claimed in claim 1 consisting essentially of one inner substantially rigid tube and one outer substantially rigid tube.

15. A composite tube as claimed in claim 1 wherein said tubes are concentric and have a substantially circular cross section.

16. A helically shaped article wherein at least some of the flights of said helix comprise an inner and an outer band spaced apart from each other with a plurality of ribs disposed therebetween in supporting relationship to said flights.

17. An article as claimed in claim 16 wherein said ribs are disposed substantially perpendicular to said inner band.

18. An article as claimed in claim 16 wherein said ribs are disposed at an angle from perpendicular to said inner band.

19. An article as claimed in claim 18 wherein alternating ribs are disposed at opposite angles from perpendicular to said inner band.

20. A method of forming an elongated composite tube comprising spaced apart at least one inner and at least one outer walls and ribs helically disposed between said inner and outer walls in supporting and supported relation to said ribs, wherein said method comprises:

co-extruding a smaller diameter tube and a larger diameter tube in concentric relation to each other;

extruding a plurality of radially spaced apart ribs so as to dispose them between, and in supporting relationship to, said smaller and larger tubes whereby forming a composite tube; and

applying a radial twist to said extruded composite tube while it is still in a formable condition, by causing said walls to axially rotate relative to the axis of extrusion; whereby causing said ribs to become helically disposed and shaped relative to at least two adjacent of said walls along at least a portion of their axial length.

21. A composite tube as claimed in claim 7 wherein all of said ribs are alternately disposed at positive and negative angles, respectively, with respect to a perpendicular to said walls.

22. A method as claimed in claim 20, wherein said walls are concentric.

23. A method as claimed in claim 20 wherein a cross section of at least one of said tubes is substantially circular.

24. A method as claimed in claim 20 wherein at least some of said ribs are angularly disposed relative to a perpendicular to at least one of said tubes, and wherein adjacent ribs are disposed in alternating positive and negative angular relationship with said perpendicular.

STATEMENT UNDER ARTICLE 19

Favorable consideration of this application is solicited.

Claim 1 has been amended to more particularly define the instant invention. Claim 3 has been amended to delete "at least" therefrom. Claim 4 has been canceled since its subject matter has been incorporated into claim 1. The dependencies of claims 5, 6, 7 and 9 have been changed for consistency. Claim 21 has been added dependent from claim 1 and specifically claiming that the ribs are at alternating angles with respect to a perpendicular to the tubes. Claim 20 has been amended to better describe the instant invented method of making the claimed product. Claim 22-24 have been added to show various preferred embodiments of the claimed method.

The four (4) references cited by the examiner have been considered and the claims of this application amended to avoid the inadvertent applicability of the disclosures of these references. Specifically, the instant invention is directed to multiple (double or more) walled pipe having a relatively rigid outer wall, a relatively rigid inner wall, and a series of rigid ribs disposed between at least two of the walls at angles that diverge from the perpendicular, with respect to the walls. The broadest claims are directed to this scope of invention. In a preferred embodiment, these ribs are disposed in a helical configuration and in a most preferred embodiment, the oppositely slanted helical ribs are joined to the inside and outside, respectively of the outer and inner tube walls so as to form triangular or trapezoidal cells that preferably extend helically between the walls. More specific claims are directed to these aspects of this invention.

None of the cited references discloses a structure as claimed. Specifically, no cited reference shows the combination of a rigid double walled pipe with ribs between the walls where the ribs are not perpendicular to the walls, but rather at an angle with respect to the perpendicular to the walls. Certainly, no reference discloses that such ribs are helically shaped. No cited reference discloses such a double walled pipe with a smooth outer wall.

The Sorensen patent discloses a collapsible hose. In order for the hose to collapse, the ribs too must be in a bendable form. This is particularly true of the embodiment shown in Fig. 3 of the reference. Note column 2 where these ribs are referred to as flexible retainer members. By way of contrast, the instant ribs must be rigid. It is clear that the differences between the structure disclosed by the reference and that of the instant application are due to the different uses to which they will be put. The reference structure is for a suction fire hose. It must be flexible and be able to collapse for storage on a truck bed. It must withstand expansive forces acting on it by the water being sucked there through. The instant claimed article is directed to a core structure for use in wrapping flat, sheetlike materials, such as plastic film. It necessarily must be rigid and resist being crushed because of the compressive effect of the material wound on the roll. Because of the different structures of the tubes being supported and the uses to which these articles are being put, their structure is necessarily different. One could no more effectively wind plastic shrink wrap film on a fire hose than one could efficiently pass fire water around a corner through the rigid structure of the instant invention. It is to be noted, however, that the instant invented structure with a set of helical ribs could find good use as a very strong fire hose.

No reference discloses the method of making such a double walled pipe as claimed where the walls (that is the whole extrudate) are rotated relative to the axis of extrusion so as to twist the ribs into a helical form. No reference has been cited for this proposition.

One use of this double walled pipe is that it can be cut following the helical pattern of the ribs, or across the helical pattern of the ribs, to form a slinky like toy. More importantly, one significant use of this product is as a core upon which can be wound plastic film, carpet, textile material, paper and other flat goods. This double walled core is very light weight and has unexpectedly high crush resistance on a weight basis. Neither of these uses is disclosed in any cited reference.

It is therefore urged that the instant claims be identified as being allowable.

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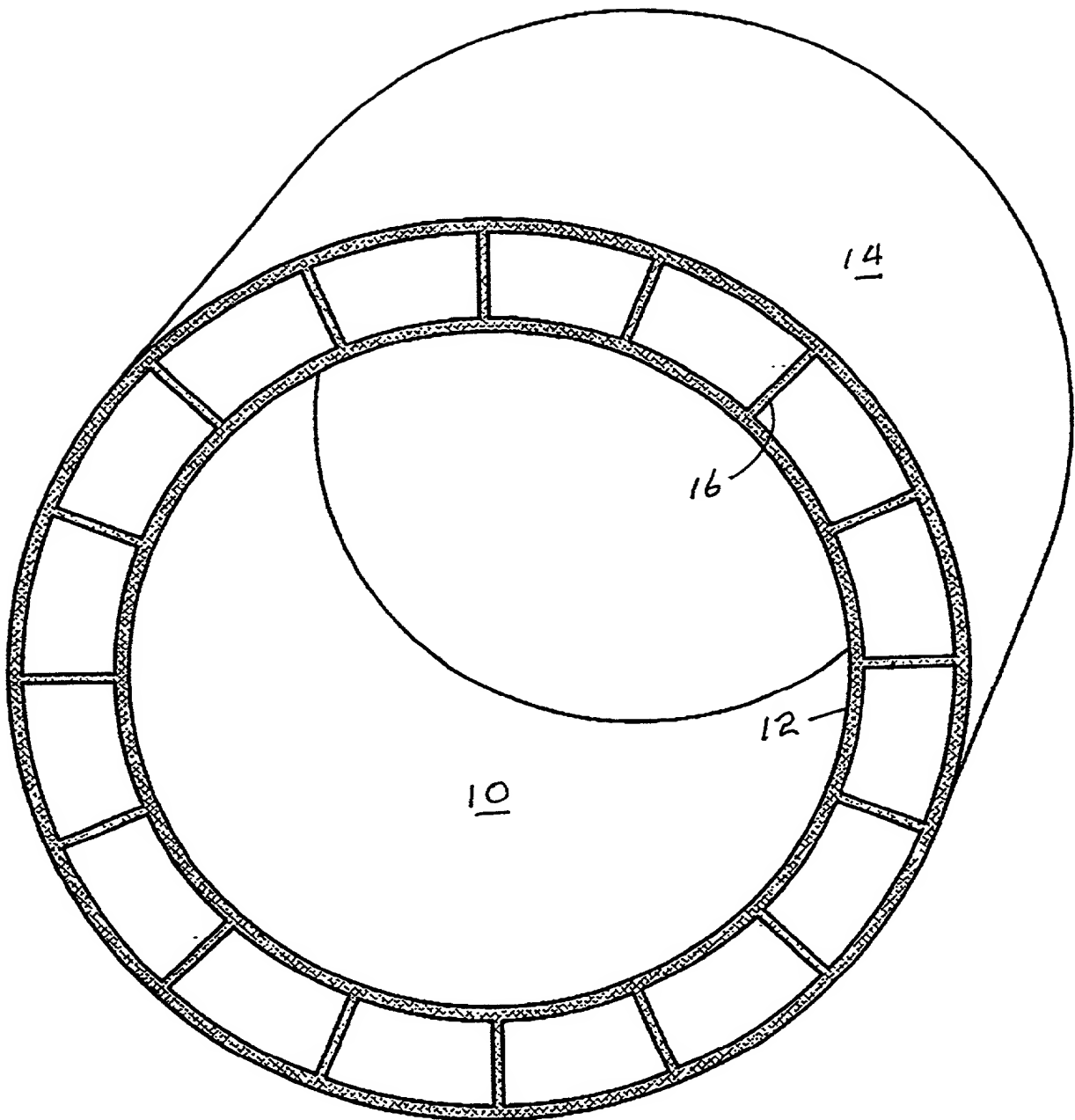


Fig. 1

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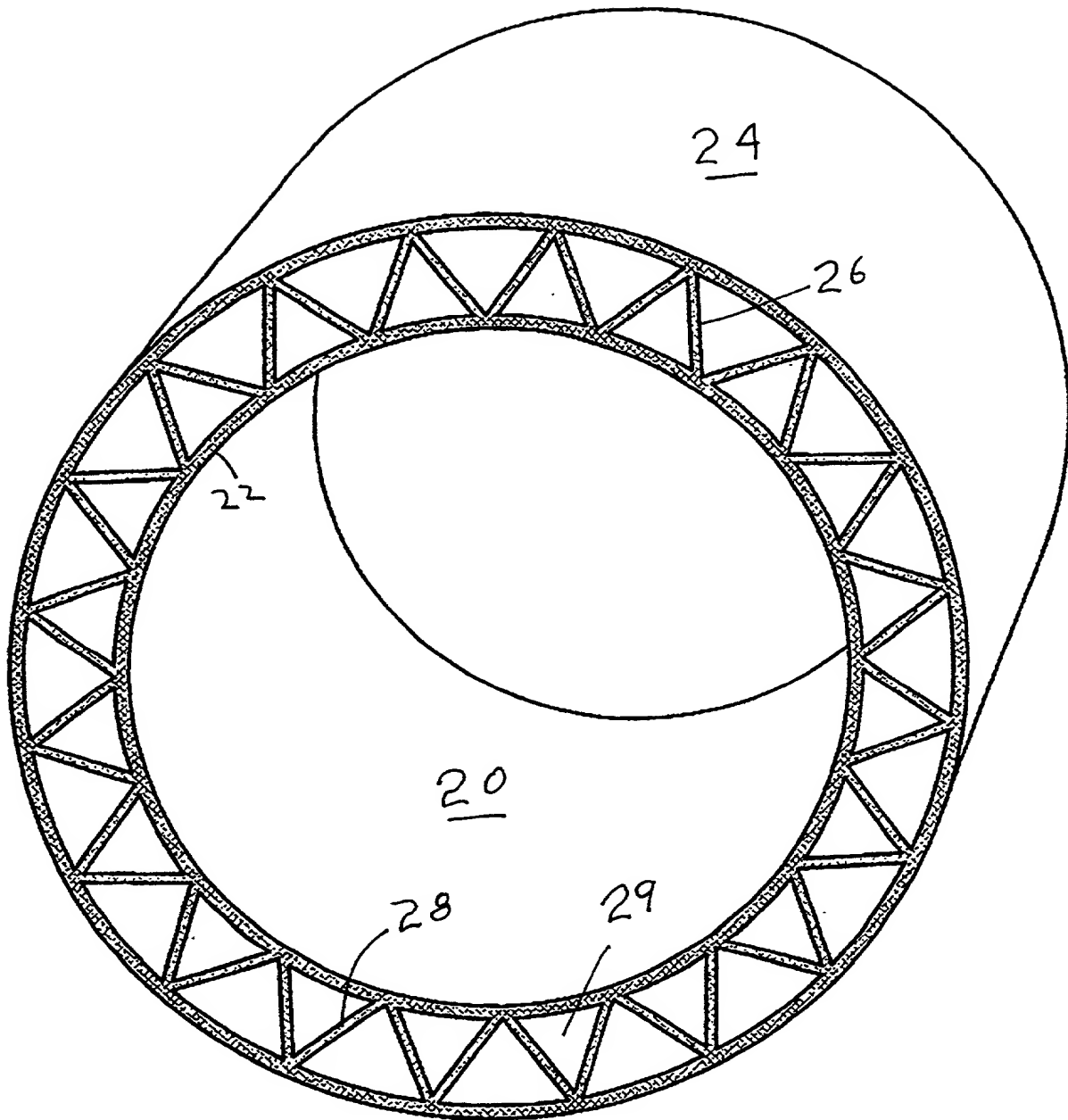


Fig. 2

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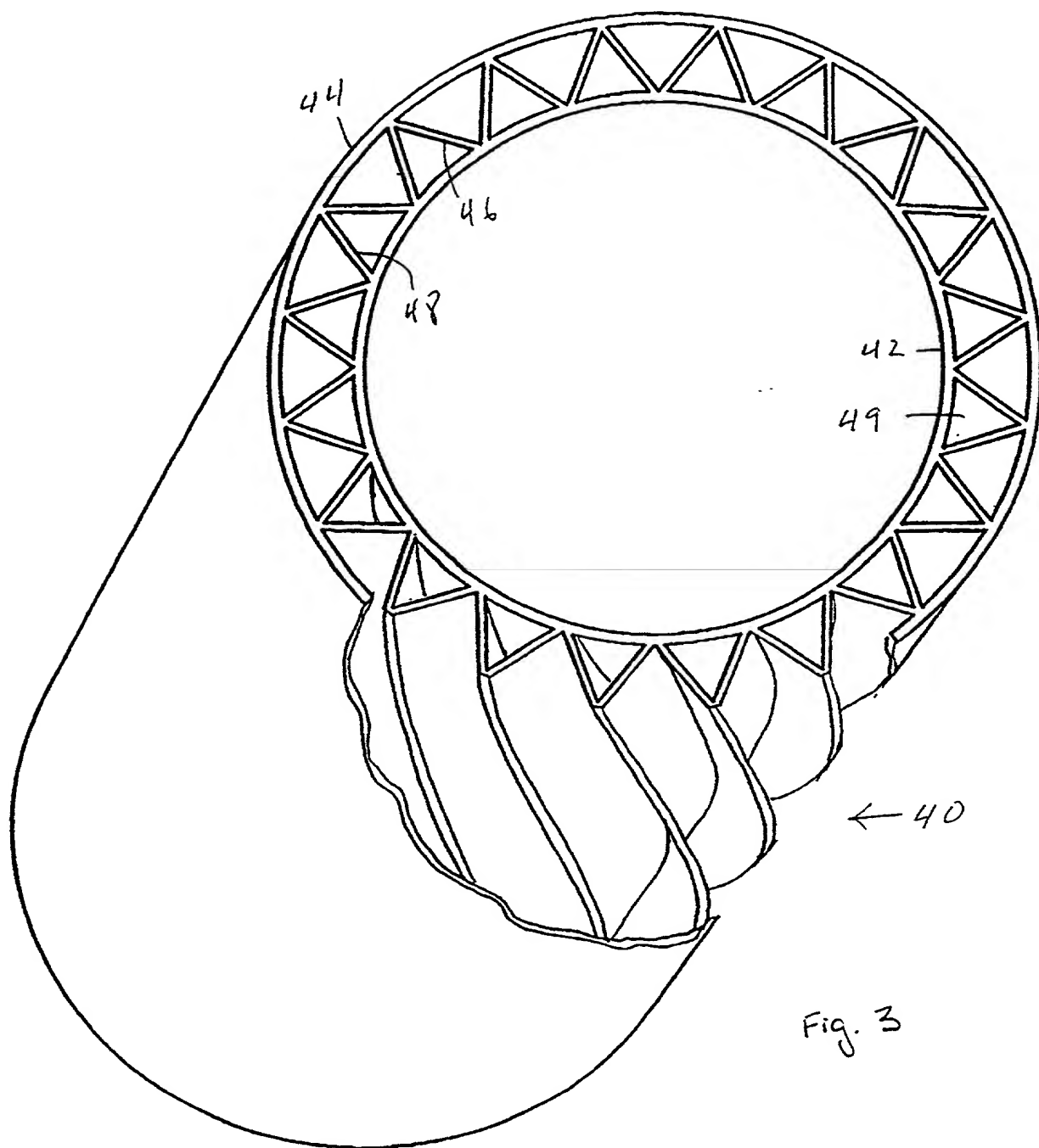


Fig. 3

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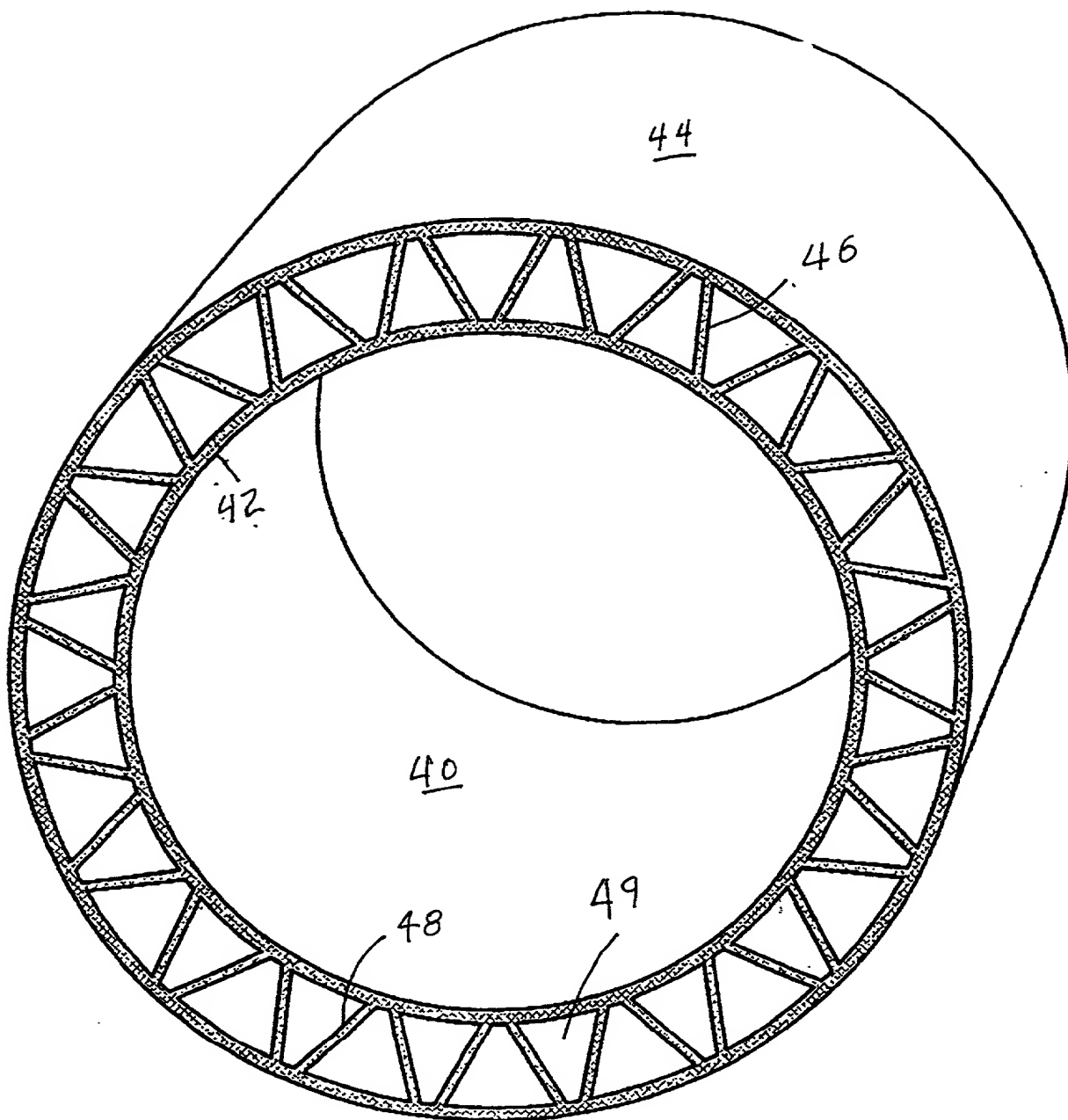


Fig. 4

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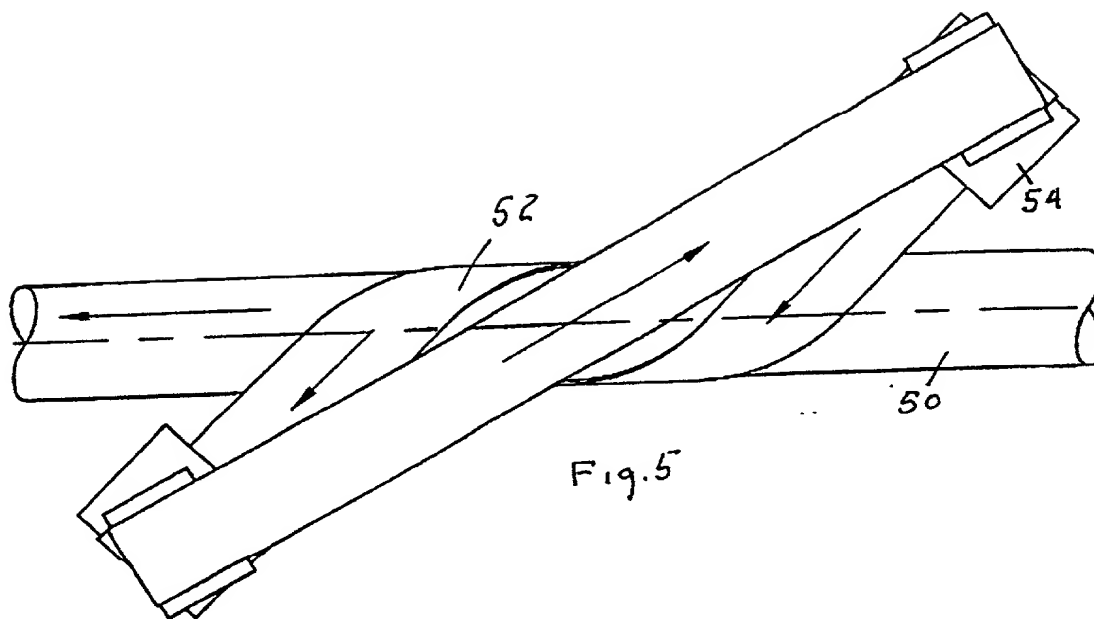
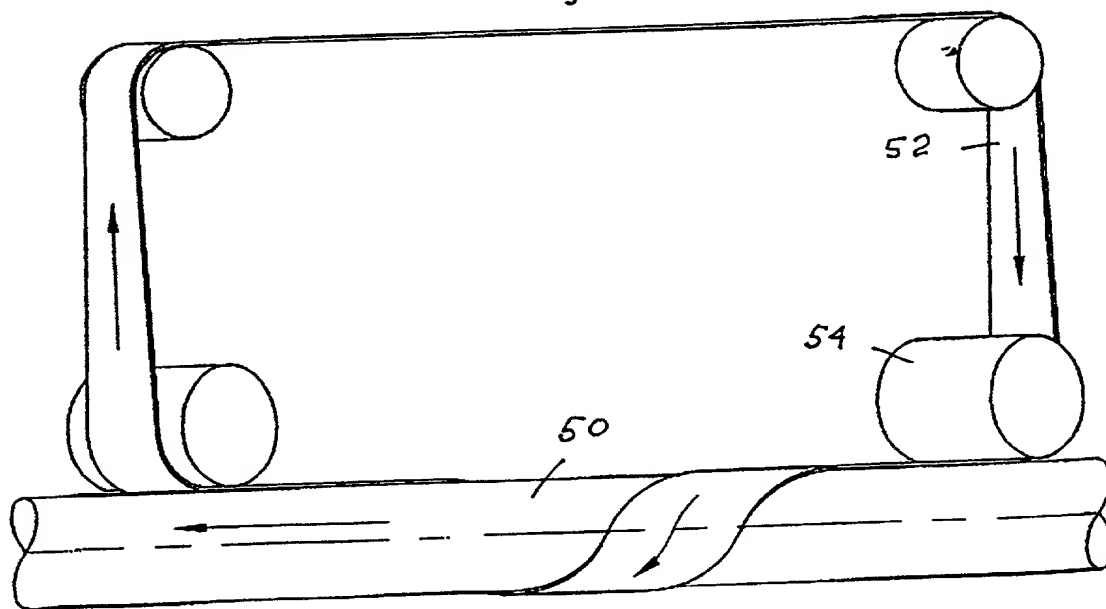


Fig. 6



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Fig. 7

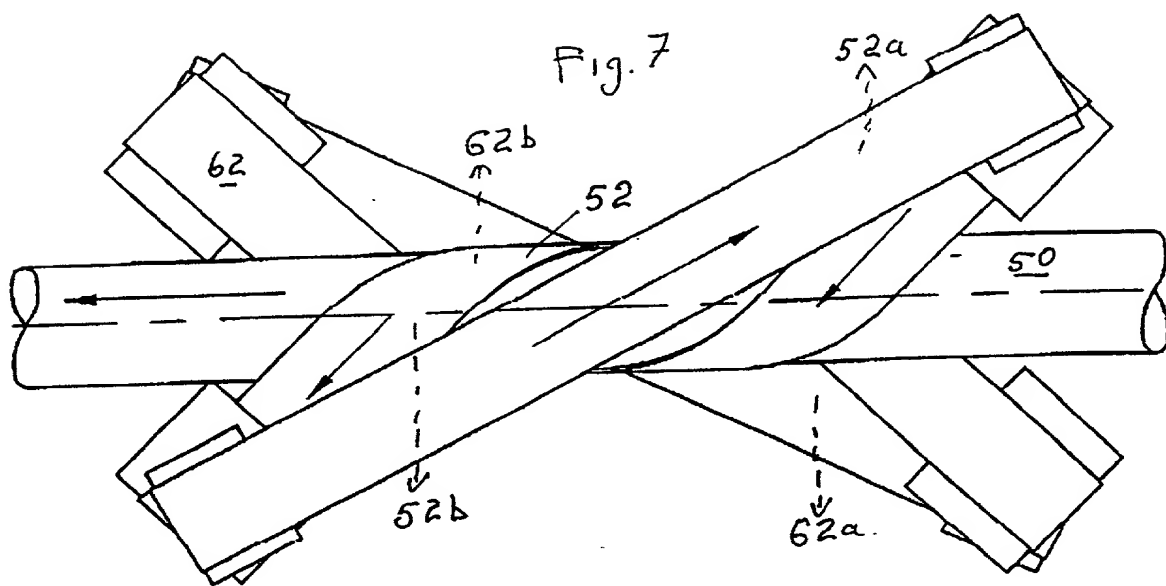
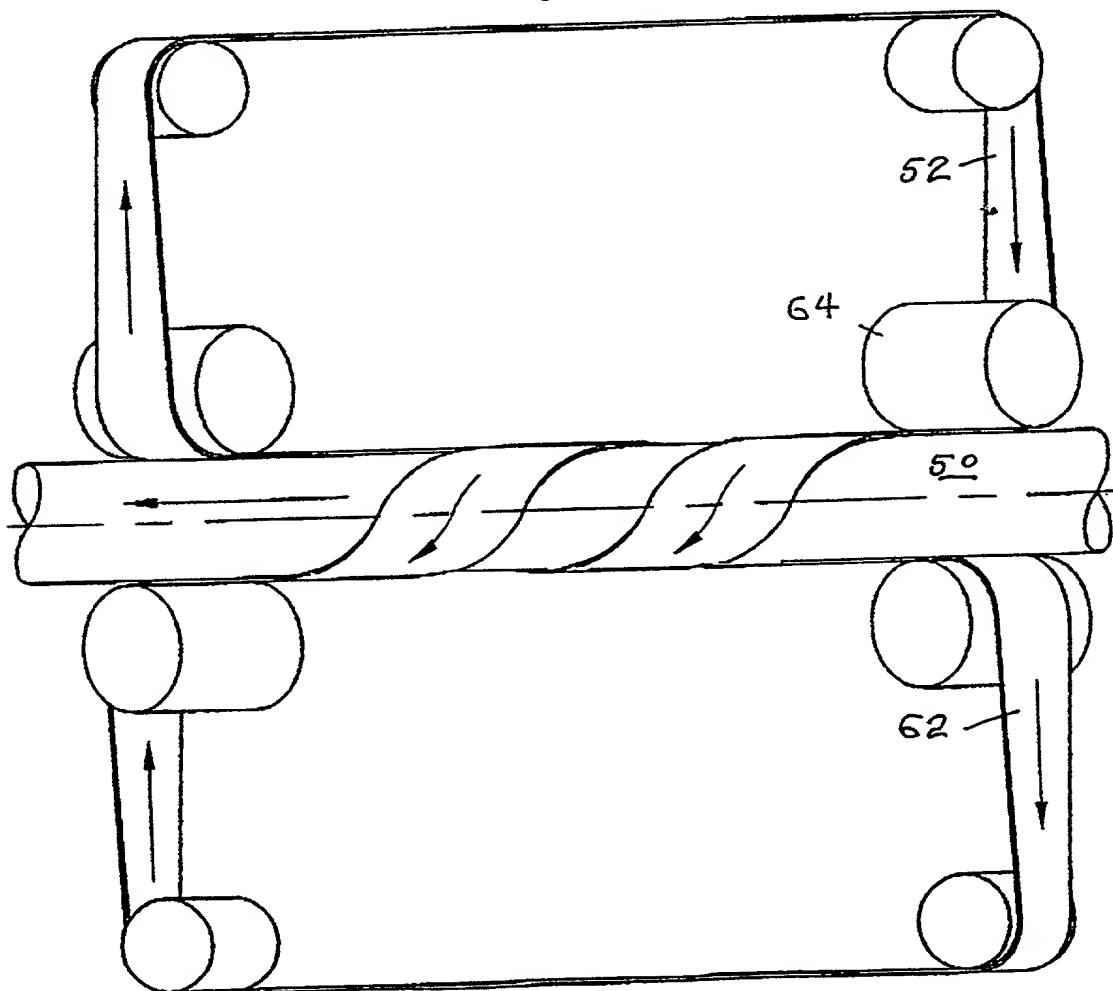
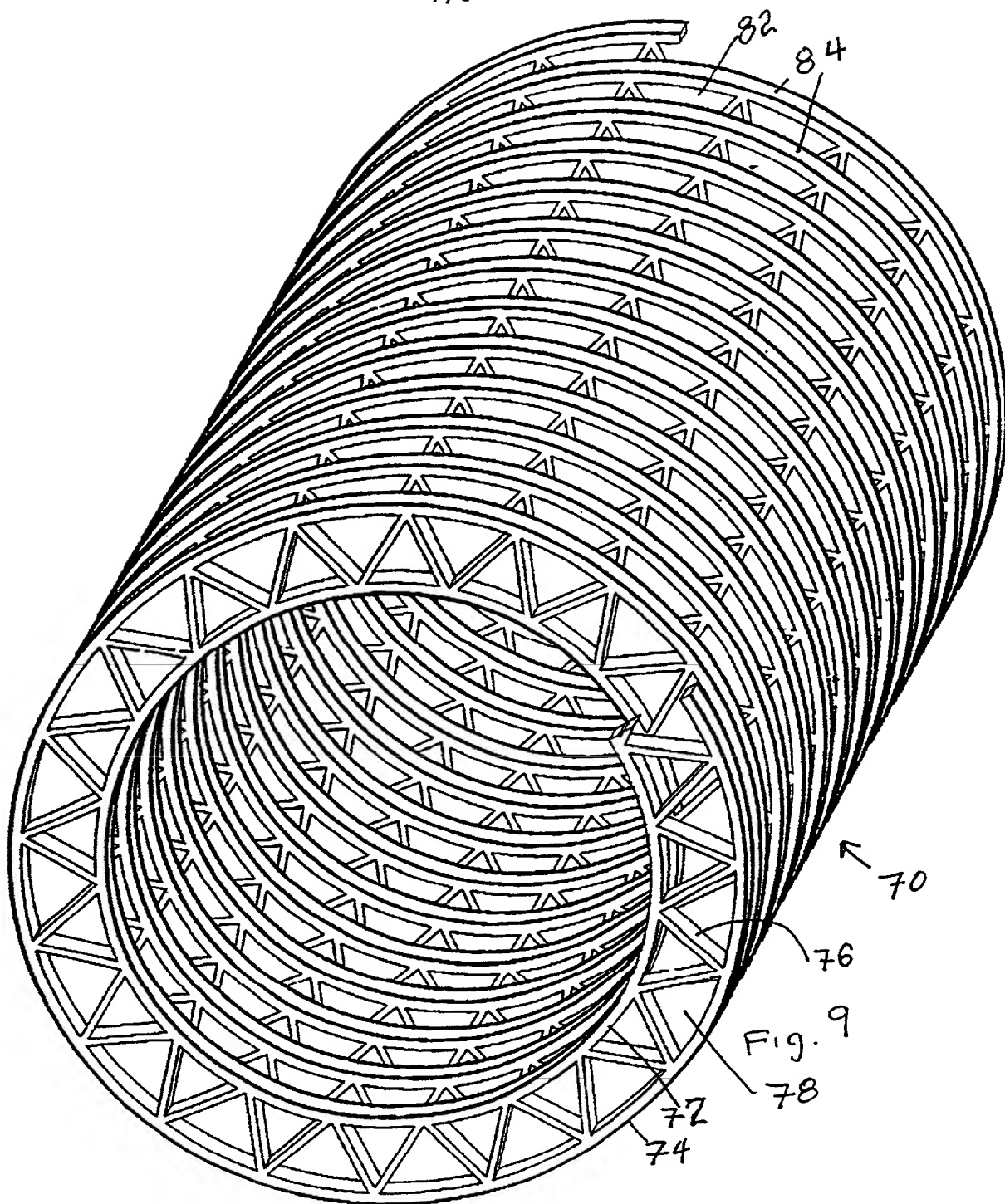
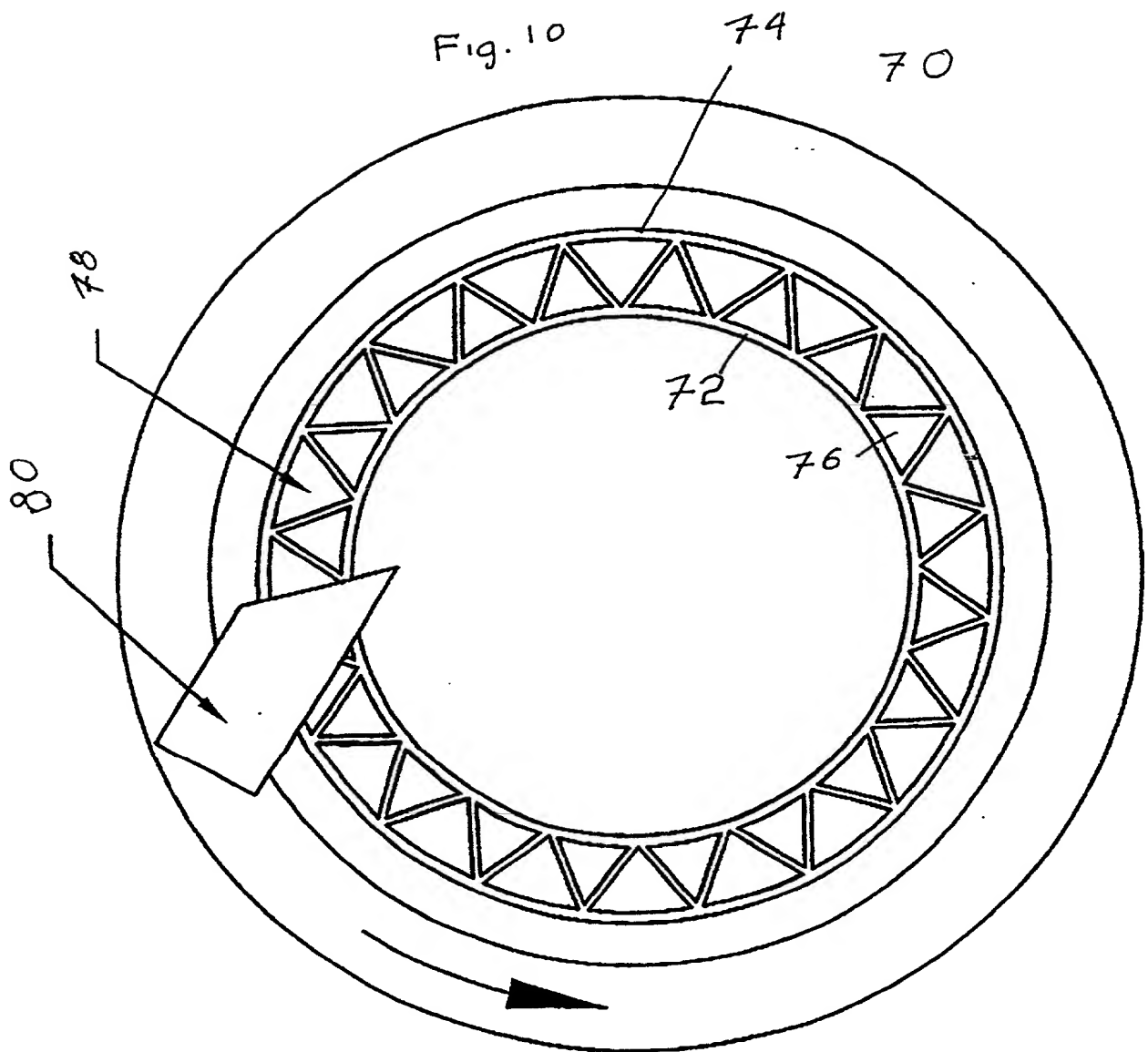


Fig. 8



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Docket No.: 4393-002

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter claimed and for which a patent is sought on the invention entitled **RIBBED CORE DUAL WALL STRUCTURE**, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known to me to be material to patentability in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):

<u>Number</u>	<u>Country</u>	<u>Day/Month/Year filed</u>	<u>Priority Claimed</u> <u>Yes or No</u>
PCT/US99/17172	WO	29 July 1999	Yes

I hereby claim the benefit under 35 USC §119(e) of any United States provisional application(s) listed below.

Prior Provisional Application(s):

<u>Application Number</u>	<u>Filing Date</u>
60/101,935	September 25, 1998
60/096,237	August 12, 1998

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(e) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U. S. Application(s):

<u>Serial Number</u>	<u>Filing Date</u>	<u>Status</u>
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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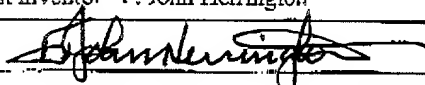
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I hereby appoint the following attorney(s) and/or agent(s): Allan M. Lowe, Reg. No. 19,641; Israel Gopstein, Reg. No. 27,533; Benjamin J. Hauptman, Reg. No. 29,310; Kenneth M. Berner, Reg. No. 37,093; Michael G. Gilman, Reg. No. 19,114, and Randy Norzbrack, Reg. No. 42,940, all of

LOWE HAUPTMAN GOPSTEIN GILMAN & BERNER, LLP
1700 Diagonal Road, Suite 310
Alexandria, Virginia 22314

with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and all future correspondence should be addressed to them.

Full name of sole or first inventor: F. John Herrington

Inventor's signature: 

Date: 7/26/00

Residence: 59 Michigan Street, Bloomfield, New York 14469-9339

Citizenship: USA

Post Office Address: same